**"Incremental Termination of Safeguards During D&D Activities**
**At**
**Savannah River Site"**

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## ABSTRACT

The Savannah River Site (SRS) is currently in the process of Deactivation and Decommissioning (D&D) several process areas. These areas currently include M Area Transitional Nuclear Material (MTN), Naval Fuels (247-F), 221-F Complex (FB-Line/F Canyon), and Receiving Basin for Offsite Fuels (RBOF). These activities are expected to continue over the next several years. This paper addresses the Material Control and Accountability (MC&A) guidelines that have been developed for D&D activities at SRS. These guidelines were developed jointly with the cooperation between the Westinghouse Savannah River Site (WSRC) MC&A, DOE-SR MC&A, and WSRC Operations organizations.

The MC&A D&D guidelines developed address topical areas that can impact activities associated with facility closures. Several areas of concern are: material hold-up, hold-up measurements, nuclear material access and surveillance requirements, updating accountability records, transition to lower category MBAs, usage of administrative MBAs, and the termination of safeguards. The goal of the guidelines were to stress the MC&A programmatic requirements identified within the DOE M 474.1-1B, Manual for the Accountability of Nuclear Materials while managing the potential impact on the D&D activities in an identified area.

## Termination of Safeguards - A Three Step Process

Savannah River Site has developed a three step process for safeguards termination that is flexible enough to cover all facilities regardless of what was processed or stored at the MBA while meeting the intent of the DOE order requirements. The development of this process was implemented only after a great deal of thought and insight was focused on the requirements and how best to satisfy these requirements without impeding the efforts of operations.

The three step process follows:

- pre-planning requirements
- deactivation and/or decommissioning
- partial or complete termination of safeguards

### Pre-Plan Requirements

Arguably the most important step of all termination functions is to properly Pre-Plan the D&D activities in an effort to mitigate unexpected events. It is nearly impossible to eliminate all unexpected events that will occur during the D&D operations, however, a carefully laid out plan will minimize the safeguards impact of such an event and maintain focus and direction on the D&D operations.

A collaboration of personnel combining the efforts from facility operations, engineering, measurement and MC&A must be involved. The idea here is to accurately provide data identifying the facility's current status as well as past events and processes that have occurred that will have an impact on the D&D activities. This review includes but is not limited to the following:

- The nuclear material currently in the facility
- Past nuclear material either processed or stored within the facility
- The current categorization of the facility and categorization goal.
- Types of activities planned to clean out existing materials
- If the facility will be demolished (decommissioned) or abandoned in place (deactivated)
- Holdup remaining in the facility/measurement plans for holdup
- What safeguard program requirements will be continued during D&D activities (e.g.: physical inventories, material controls, etc.)
- Transfer of custody to a waste organization upon completion of activities, or termination of safeguards in place.

The nuclear material currently in the facility provides the basis for how the D&D activities will begin and how termination of safeguards will be implemented. Questions concerning the status of material such as; will it remain in the MBA or be transferred to another facility must be answered prior to the initiation of D&D activities. This also helps to support the goal for the final category determination. If a quantity of material is to remain in the MBA then the downgrade of categorization and the possible development of an Administrative MBA will have to occur. If all material is to be removed and the building demolished, then complete termination of safeguards may be possible. From the pre-planning phase determination on the desired final facility status will have been determined. (eg. Deactivated and/or Decommissioned)

**Deactivation and/or Decommissioning**

Deactivation involves the process by which all active inventory is removed from the MBA, however, a certain amount of static inventory or holdup may remain. To better understand this concept some terms should be defined as applied to Savannah River Site operations.

- Active Inventory is defined as nuclear material contained within the MBA that is being moved or processed. For category I, II and some III processes active inventory enters into the calculation for limit of error and control limit considerations.
- Static Inventory is defined as material maintained in a storage configuration that roll up with the active inventory and account in the current categorization of a facility.
- Holdup includes the amount of nuclear material remaining in process areas and associated equipment after all of the in-process and stored materials have been removed and is part of the static inventory.

Deactivated Facilities at the SRS no longer perform physical inventories evaluate inventory differences, perform confirmation/verification measurements, and greatly reduce material surveillance. An example of a Deactivated facility at the SRS is the Receiving Basin for Offsite Fuels (RBOF). Here we systematically removed all inventory from the facility. The goal for this facility was to completely terminate safeguards once all the material was removed. It did not work out the way we had planned due to some unexpected events that occurred during the early stages of the D&D activities. During one campaign of fuel handling we had a problem with an assembly which leaked a certain amount of oxidized fuel into the basin. This material circulated throughout the basin and settled in the residual sludge at the bottom. After all the items were removed from the basin a vacuuming and characterization campaign was initiated. Once characterized the vacuum canisters containing the sludge were transferred to another MBA. However, even with the best efforts of our facility operations personnel, sludge material remains in the bottom of this basin which prohibits a complete termination of safeguards at this time.

The RBOF facility was initially a category II MBA; with the removal of material the MBA was incrementally downgraded to a category IV facility. The MBA no longer performs physical inventory and have greatly reduced their material surveillance program; but the RBOF MBA remains on our accountability books as an administrative MBA with a quantity of static inventory (holdup).

Decommissioning on the other hand involves all the steps with Deactivation and also the complete termination of safeguards with all the requirements in DOE M 474.1-1B satisfied. According to DOE M 474.1-1B, Chapter I, Section i., (1)(a)(b)(c) states: "To exempt accountable quantities of nuclear materials from requirements of the manual, (i.e., terminate safeguards) the material must meet the following requirements:

1. The material must be attractiveness level E if it is SNM. (DOE M 474.1-1B, Table I-2)
2. The material has been determined by DOE/NNSA to be of no programmatic value to DOE/NNSA.
3. The material is transferred to the control of a waste management organization where the material is accounted for and protected as waste. The material must not be co-located with other accountable nuclear materials."

Decommissioning involves the complete removal of all active and static inventory to include all hold up. At Savannah River Site, holdup has been our Achilles' heel. As identified above to terminate safeguards on material it must be attractiveness level "E". We have some processes that do not meet this criteria and it requires some creative mechanisms to downblend approved holdup materials to a lower attractiveness level. Some of the methodologies employed at Savannah River Site have included mixing the holdup with diatamatious earth, use of absorbent materials, sending the material to another facility for dissolving, and mixing the material with concrete to reduce the weight percent to meet the requirements.

At our 247-F facility the goal was to completely terminate safeguards but to do so incrementally. We removed all active and static inventory with the exception of holdup. We downgraded the facility from a Cat I to a Cat IV and followed up by measuring the holdup material remaining in the facility. Once it was determined to be category IV with only holdup remaining, the MBA was Deactivated (static) for a period of ten years. In 2002 there was a push to decommission/demolish the facility so a pre-planning team was formed and comprised of site experts. The team decided to divide the facility into one hundred zones and assigned a gram quantity to each zone based on the measured holdup values. The D&D activities authorize the systematic removal of material by zone from our accounting books. At the end, all process holdup will be removed with the exception of one area. The concrete pad on which the building stands has been identified to contain material from spills in the process. The material over a long period of time has leeched into the concrete. Although the material in this form is category IV, attractiveness level E, we cannot terminate safeguards on the pad until this material has been removed and sent to a waste management organization. We will have to scabble these areas up when we are finished removing the building and send this waste material to waste management. At that time we can completely terminate safeguards and remove the MBA from our accountability books.

**Partial or Complete Termination of Safeguards (see attachment 1)**
The important point to remember here is that Partial Termination of Safeguards goes hand in hand with the Deactivation process. It is a process by which we will downgrade the facility's categorization in an effort to reduce the MC&A and physical security requirements. At best a deactivated facility will no longer perform physical inventories, inventory difference evaluations, and confirmation/verification measurements. There still will be requirements to keep the MBA on the accountability books for perpetuity or until decommissioning is complete.

Complete Termination of Safeguards follows the path of a decommissioned building where we plan on demolishing it and removing all forms of material to include holdup. At SRS the difference in the types of termination (eg. Partial or Complete) has ALWAYS been the result of the holdup material and the configuration it is in.

Holdup has been a real challenge at SRS so we separate this into its own category for review during the pre-planning phase. Holdup must be handled with extreme care, or a facility may suffer some very serious consequences that can result in the suspension of the operation.

At SRS we have two different types of holdup and terms we use for each. The terms we use are: recoverable holdup or "process holdup", and unrecoverable holdup or "equipment holdup".

- "Recoverable holdup" is the material that can be "recovered" during the D&D operations of a facility. This material may have been affixed-to system

components and materials, but during the D&D process the material was loosened or opened and can now be collected. Within the accounting system this type of material is also referred to as "process holdup".

- "Unrecoverable holdup" is material that is inaccessible in the facility even during the D&D process. This material is embedded in and affixed-to system components and material (glass, plastics, metals, concrete slab, etc.). This equipment hold-up is considered beyond economical and technical recovery. This type of holdup is referred to as "equipment holdup" within the accounting system.

When a facility is going through the D&D process and all active and static inventory has been removed, it is now time to perform holdup measurements. Holdup measurements must be performed on all areas that processed material. Any equipment remaining in these areas that once contained material must also be measured or estimated. At SRS it has worked best to section areas off where holdup measurements are to be performed. This is effective because it allows the measurement group to easily identify where they have started and stopped for a given time period, and where to resume should they leave the area and have to return. Holdup measurements are a very time consuming and costly feature of the Safeguards D&D work. It is also the feature with the greatest uncertainty concerning material configuration and isolated location, however, it is absolutely the most essential step in preparing a facility for termination of safeguards.

Assuming that all holdup material is always category IV, attractiveness level E can prove to be a fatal flaw to the D&D closure operation. Holdup, unless it is proven to be different, is the category of total SNM put into the process during its lifetime. This requirement is outlined in the MC&A DOE Manual and basically requires us to identify and measure holdup or termination of safeguards for a facility will be highly unlikely. If a facility processed Uranium Oxide then it is probably certain that the holdup in the MBA will be Attractiveness level C. If the oxide is embedded in the equipment with no means of recovering, the material then based on weight percent can be discarded. However, if the material breaks loose during the Safeguards D&D operation or recoverable holdup is found in an area that was not expected, our contingency plan identifies the following sequence of events:

- A "Stop Work" order is issued
- An immediate assessment is performed by radiological controls personnel and immediate notification to the facility management team and site MC&A.
- For material where radiation levels indicate greater than the general area, the MBA Custodian and Criticality Engineering will be contacted immediately.
- If the material discovered shows a large increase in radiation levels, Nuclear Measurements Group will be required to perform a field analysis. This analysis will be compared to the NDA values assigned to the original holdup value.
- If the material is within the uncertainty of the value assigned to the holdup, then no adjustment will be made to the accountability records.

- If the material is in excess of the uncertainty of the value assigned to the holdup, then the accountability records will be adjusted accordingly.

Furthermore, if the material is determined to meet the criteria for attractiveness level "C" then the material shall be continuously monitored by one appropriately cleared person until one of the following is performed:

- The material is dispersed throughout other non SNM D&D waste and the SNM gram content is less than the weight percent for E material in DOE M 474.1-1B.
- The material is down blended in accordance with approved procedures.
- The material is packaged and shipped to another facility.

The final decision for resolution rests upon a combined analysis from facility management working in parallel with site MC&A. Holdup, although a very small part of the facility inventory can cause the biggest problems during the D&D operations.

**Attractiveness Level E Material**

At Savannah River Site Category IV, Attractiveness Level E, does not constitute an automatic write-off of material. Over the past couple of years, the method of operation is more in lines with a special discard request. As mentioned earlier, just because it is "E" material does not automatically mean you may send it to a waste management organization. Further, many of the facilities that are going through the D&D process were once processing facilities that contained quantities and forms of material that did not render itself to attractiveness level E. It is for this reason that a discussion on what constitutes E material is imperative. By definition E material is SNM with an enrichment less than 20% U-235 or less than 10% U-233/PU. Further it is broken down by weight percent depending upon what configuration it is in, but in most cases at SRS less than .2 weight percent constitutes attractiveness level E. Please remember that this is not always the case and each situation must be evaluated independently to identify the correct form so that accurate analysis for attractiveness level can be determined.

**Discards**

During the D&D process the facility will have to discard nuclear material. When all hold up has been measured and the facility is ready to start removing the process equipment and superstructure, a special discard approved by both site MC&A and local DOE-MC&A is required. The discard should identify the total holdup amount in the building to be decommissioned/demolished. There have been instances in our M-Area facilities where the facility is going through decommissioning prior to holdup measurements being established. This was an oversight during the pre-plan due to the fact that the buildings in questions were not processing areas but may have contained small one room labs. Once the building was down a smear to curie measurement was performed on the debris and it determined an accountable quantity of nuclear material was present. Even though it was Category IV attractiveness level

E and based on weight percent it would fall well below the .2% criterion for safeguard termination a special discard is required before the material is sent to a waste management organization. Further, the material was not on the accountability books so the material MUST be placed on the books and then removed once shipped to an authorized waste management organization.

***Inventory Differences***

Inventory Differences is another consideration that must be evaluated. In the mid 1990's the DOE published cumulative historical ID values for many current weapons facilities. In some cases, these numbers were relatively large and were the subject of many inquiries; Savannah River Site was no exception. Over years of processing at Savannah River Site, many Inventory Differences (ID's) have been explained as hold-up quantities of material. Thought must be given to approaches to monitor material recovery and these measurement values be correlated back to their historical IDs as materials are removed, re-measured, and packaged as waste. It is anticipated that the removal of waste from the D&D facilities would offset and ID trends identified during processing activities.

**Summary**

It is imperative to have a well thought out program prior to initiating D&D activities at a facility. No matter how well thought out, any program must be dynamic and capable of adapting to change quickly. The Savannah River Site three step process to safeguards termination has been designed dynamic and will continue to change as different facilities begin the D&D process. This process has made significant contributions to the D&D effort and fostered positive DOE feedback. The process has encouraged a unified team between operations, site MC&A and the DOE-SRS. Most importantly the process allows for several different stages of termination while meeting the requirements in the DOE M 474.1-1B and without overly impacting the functionality of the WSRC D&D program.

**References:**

DOE Manual 474.1-1B, Manual for Control and Accountability of Nuclear Materials, June 24, 2003

WSRC Manual 14Q, Material Control and Accountability Manual, November 18, 2003

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## Stages of D&D Termination

| Facility/MBA | Physical Inventory | LEIDs | Confirmation/Verification Measurements | Material Surveillance | Accounting System |
|---|---|---|---|---|---|
| **Receiving Basin For Offsite Fuels (RBOF)** | No | No | No | No | Yes |
| **Naval Fuels (247-F)** | No | No | No | No | Yes |
| **M-Area Transitional Nuclear Material (MTN)** | Yes | No | No | Yes | Yes |
| **221-F Facility (FB-Line)** | Yes | Yes | Yes | Yes | Yes |
| **221-F Facility (F Canyon)** | Yes | No | No | Yes | Yes |